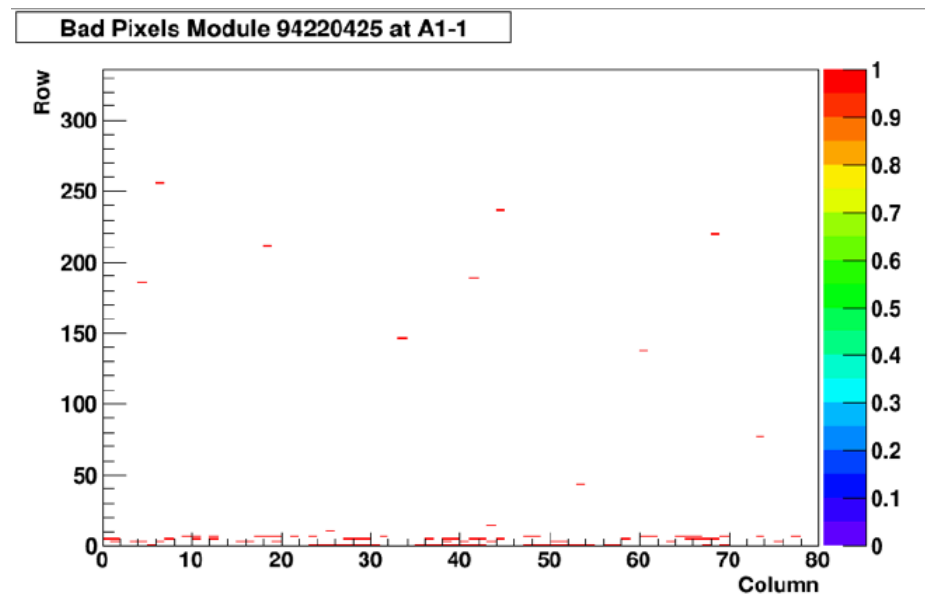
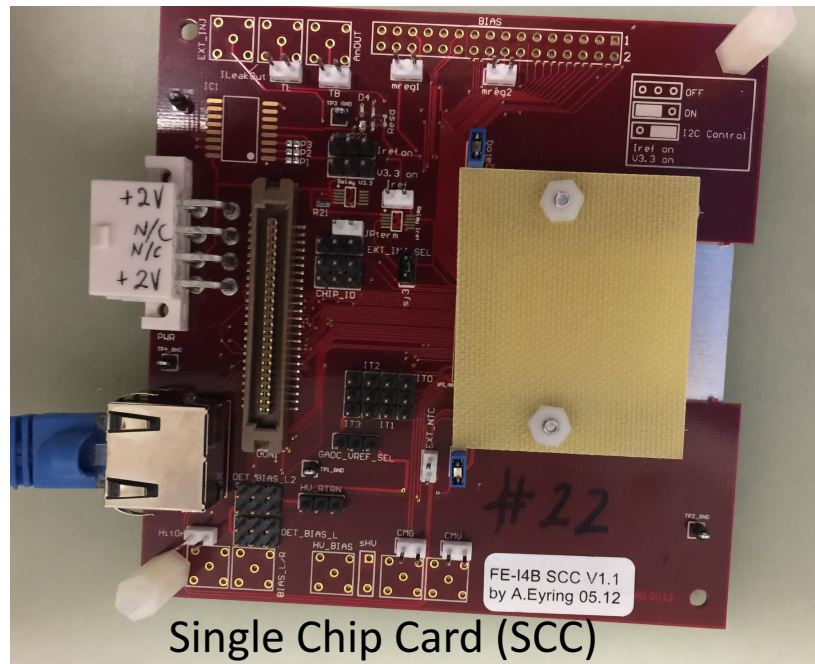


RTI Module Plans

RTI = Bump bonding vendor in North Carolina, USA

- 6 quads, 6 singles per wafer
- Micron 6" wafer spring 2016
 - 300 μm , no thinning
- FEI4
- Plan: Test beam and irradiation measurements



Tested by Matt Zhang

US ATLAS ITK Pixel Twiki:

<https://twiki.cern.ch/twiki/bin/view/USatlasITKpixel/WebHome>

- Please send me comments or edit the twiki page directly
- Please add categories as needed

Welcome to the USatlasITKpixel web

RTI Modules

Bump bonding of planar sensors with FEI4 for validation of RTI as a vendor. Spring-summer 2016

Module Information:

- Micron sensors on 6" wafers from processed spring 2016
- 300 μm thick, no thinning
- FEI4

The first batch of bump bond modules had many shorts. The measured bump size was 40 microns, reduced to 12 microns in second batch.

	Module #	type	FE	sensor type	good module	Location	Status	Irradiated	Last Updated	Comments
Batch 1:	FEI4_RTI_2016_A001-S	single chip	FEI4	Micron planar	no	RTI/LBNL?	sent for rework	no	2/8/17	bump size too large
	FEI4_RTI_2016_A001-S	single chip	FEI4	Micron planar	no	RTI/LBNL?	sent for rework	no	2/8/17	bump size too large
	FEI4_RTI_2016_A002-S	single chip	FEI4	Micron planar	no	RTI/LBNL?	sent for rework	no	2/8/17	bump size too large
	FEI4_RTI_2016_A003-S	single chip	FEI4	Micron planar	no	RTI/LBNL?		no	2/8/17	bump size too large
	FEI4_RTI_2016_A004-S	single chip	FEI4	Micron planar	no	RTI/LBNL?		no	2/8/17	bump size too large

Proposal to discuss

Test beam:

- 6 single chip cards
- 6 quads?
 - Still testing quad flex cable

Irradiations (Qualify to 4,000 fb⁻¹):

- 4 single chip cards (quad modules if ready in time)
- 2 with neutrons
 - What fluences? 5e15, 2e16 1 MeV n_{eq}/cm²
- 2 with gammas
 - What doses? 100 Mrad, 1 Grad
- Or maybe we only want to irradiate 1 of each to save for later?

Batch 2:	FEI4_RTI_2016_B001-S	single chip	FEI4	Micron planar	yes	SLAC	mounted on SCC, used in test beam fall 2016	no	2/8/17
	FEI4_RTI_2016_B002-S	single chip	FEI4	Micron planar	yes	SLAC	mounted on SCC, used in test beam fall 2016	no	2/8/17
	FEI4_RTI_2016_B003-S	single chip	FEI4	Micron planar	yes	ANL	mounted on SCC, tested	no	2/8/17
	FEI4_RTI_2016_B004-S	single chip	FEI4	Micron planar	yes	UCSC	?	no	2/8/17
	FEI4_RTI_2016_B005-S	single chip	FEI4	Micron planar	yes	LBNL	?	no	2/8/17
	FEI4_RTI_2016_B006-S	single chip	FEI4	Micron planar	yes	LBNL	?	no	2/8/17

Fermilab Test Beam Facility: February 22 to April 25 (9 weeks)

- Coordinating with U. Geneva, M. Benoit

Beam:

- 120 GeV protons; 8-60 GeV pions; 1-32 GeV pions; kaons, electrons, muons
- Rate $\sim 100\text{kHz}$
- 4.2 s spill every minute
- 300k-500k particles per batch
- Spot size $\sim 1\text{ cm}$

Telescope:

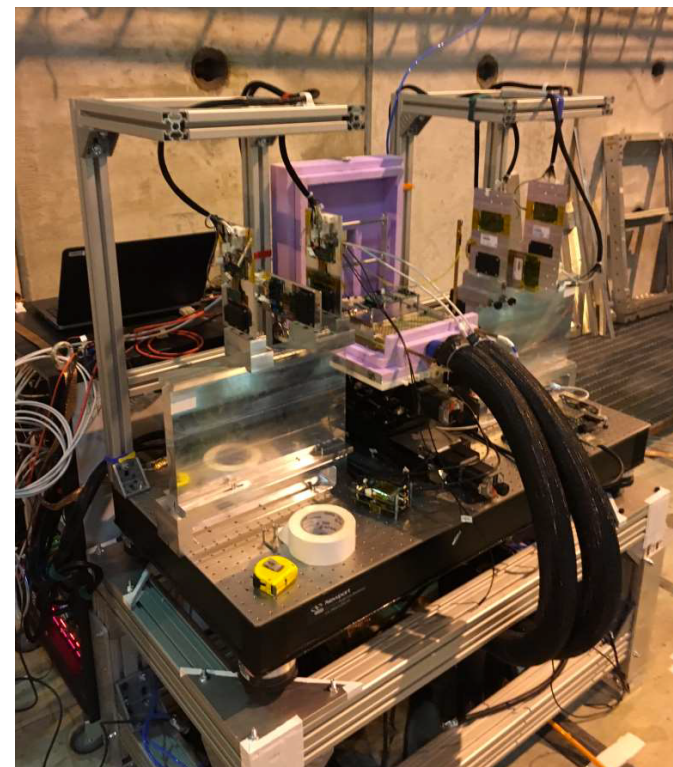
- U. Geneva FEI4 telescope
- HSIO1 readout
- 6 planes of Si sensors
- Trigger rate 6-18 kHz
- Remote controlled scanning stage
- DUT cooling

Devices:

- HVCMOS H35demo
- RTI modules

February 13, 2017

**Others are welcome
to join the test beam**

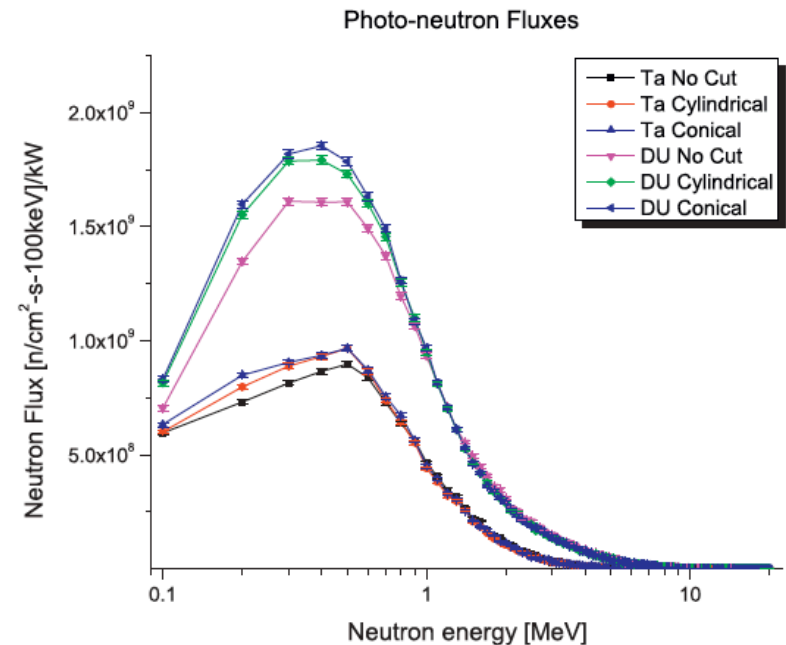


Irradiations @ Argonne:

- Nominally planned March 13-17
- Test modules in test beam before and after irradiation

Argonne Low Energy Accelerator Facility (LEAF)

- 55 MeV electron beam
- Neutron Irradiations
 - Photoneutron source
 - Peak energy 0.3-0.5 MeV u to 1 MeV
 - Flux up to 8×10^{11} n/cm² s
 - Plan: lead-boron shield for thermal neutrons, gammas
- Gamma Irradiations
 - range of 1-3 MeV



Makarashvili, NIMA 696 (2012) 136-140

Argonne Tandem Linac Accelerator System (ATLAS)

- User facility: <https://www.phy.anl.gov/atlas/facility/index.html>
- Very good range for SEU testing
- Heavy ion accelerator
- Essentially all stable isotopes from hydrogen to uranium are available
- Energies up to 17 MeV per nucleon (2.2 GeV for Uranium)

Ion ^a	Maximum Energy (MeV) for Areas III, IV*	Maximum Current at Maximum Energy (pna)	Beam Current at Energy of 6 MeV/u (pna)
⁷ Li	140	100 ^c	200 ^c
¹⁰ B ^{b,c}	200	100	100
¹² C ^b	241	1000 ^c	>1000 ^c
¹⁴ N	244	800 ^c	>1000 ^c
¹⁶ O ^b	320	>1000 ^c	>1000 ^c
¹⁹ F	334	10	50
²⁰ Ne	350	1000	>1000 ^c
²⁴ Mg	415	2	10
²⁷ Al	464	10	30
²⁸ Si ^b	476	100	>1000
³² S ^b	539	100	1000
³⁵ Cl	585	12	35
⁴⁰ Ar ^b	660	1000	>1000
⁴⁰ Ca ^b	660	200	>1000
⁴⁸ Ti ^b	778	40	300
⁵¹ V	816	0.5	2
⁵² Cr	832	10	40
⁵⁶ Fe ^b	882	50	400

⁵⁹ Co	920	10	50
⁵⁸ Ni ^b	911	20	100
⁶³ Cu	977	20	100
⁶⁴ Zn	979	4	20
⁷⁴ Ge ^b	1103	2	10
⁸⁰ Se	1160	2	10
⁷⁹ Br	1150	2	10
⁸⁴ Kr ^b	1201	500	> 1000
⁹⁰ Zr ^b	1260	140	300
⁹⁸ Mo ^b	1343	1.5	7
¹⁰² Ru ^b	1377	3	12
¹⁰⁷ Ag	1418	10	50
¹²⁰ Sn ^b	1512	2	10
¹³⁰ Te ^b	1593	2	10
¹³² Xe ^b	1597	30	150
¹³³ Cs ^b	1603	20	100
¹⁸⁰ Hf	1881	2	10
¹⁹⁷ Au	1950	10	50
²⁰⁸ Pb ^b	1997	20	200
²⁰⁹ Bi ^b	1996	20	50
²³⁸ U	2190	20	40

Proposal:

- Test all 6 RTI singles in test beam, irradiate 2-4 samples, return to test beam
- Test quad modules if there is enough time
- Test beam scheduled for February 22 to April 25
 - All are welcome to join for all or part, please let me know
- Irradiations with neutrons and gammas
 - If you have other samples to add to the irradiation, please let me know

Backup